PALMER'S

POCKET SCALE.

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POCKET SCALE,

WITH RULES

FOR ITS USE IN SOLVING

ARITHMETICAL AND GEOMETRICAL

PROBLEMS.

BOSTON:
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1845.

PALMER'S

ENDLESS SELF-COMPUTING SCALE.

THE proprietors of this invaluable work, beg leave to present the public with the following notice:

This Scale (the result of three years' incessant labor) is designed as an assistant in all arithmetical calculations. The simplicity, rapidity, and accuracy of its results have astonished our best mathematicians. It consists of a logarithmic combination of numbers, arranged in two or more circles, one of which is made to revolve within the other; which process constantly changes the relation of the figures to each other, and solves an infinite variety of problems. Its advantages are—

1st. *A complete saving of mental labor;* for, by the use of this Scale, the most intricate calculations are but a pleasurable exercise of the mind.

2d. *A great saving of time.* Computations requiring from three to four days, are wrought out by this Scale in the incredible short space of one minute.

3d. *Complete accuracy.* The results of the computations on this Scale are infallible. Errors are entirely out of the question, except through sheer carelessness.

4th. *Mental improvement.* By this Scale, a knowledge of the philosophy of numbers, and their relation to each other, is soon obtained. So that, in a little time, many of the common calculations are wrought out by the mere exercise of the mind.

RECOMMENDATIONS

OF THE

ENDLESS SELF-COMPUTING SCALE.

ROCHESTER, JAN. 19, 1842.

THE "Self-Computing Scale," by A. Palmer, is a very ingenious and interesting instrument for performing most of the operations in arithmetic. The principle is very plain; and the accuracy, and certainty, and rapidity of the results are very striking.

C. DEWEY,
Principal of Collegiate Institute.

ROCHESTER, JAN. 19, 1842.

Having particularly examined Mr. Palmer's "Self-Computing Scale," I fully concur in the above testimonials of Dr. Dewey.

SAMUEL LUCKEY, D. D.

ATTICA, MARCH 5, 1842.

From an examination of the "Self-Computing Scale," by Mr. Palmer, I can most cheerfully concur in the above recommendations, and hope it may be introduced into our schools and academies.

E. B. WALSWORTH,
Principal of Attica Academy.

BUFFALO, APRIL 5, 1842.

We have examined the above-mentioned Scale, and concur in the certificate of Professor Dewey.

W. K. SCOTT, *Civ. Eng.*
R. W. HASKINS, M. A.

BROCKPORT, FEB. 19, 1842.

I have carefully examined "The Endless Self-Computing Scale," by Mr. Aaron Palmer; and without hesitation give it as my opinion, that it will be found a very useful in-

vention. All the problems in arithmetic can be readily solved upon it, and most of them with great expedition, particularly the rules for computing interest for months and days, at any per cent., the rule of three, and fractions. In the apportionment of county, town, and school taxes, it will be found almost invaluable, as it requires to be set but once, to show each man's tax.

JULIUS BATES, M. A.,
Principal of Collegiate Institute.

CAMBRIDGE, OCT. 20, 1843.

I have examined Mr. Aaron Palmer's "Endless Self-Computing Scale;" it is simple and most ingenious, and I cheerfully concur in Mr. Julius Bates's judicious recommendations of its utility.

BENJAMIN PEIRCE,
Perkins Professor of Astronomy and Mathematics in Harvard University.

BOSTON, OCT. 24, 1843.

Mr. Palmer's "Self-Computing Scale" is certainly a very ingenious arrangement of numbers, and it will save a great amount of time in the hands of those who have computing to perform, whatever be the subject of the computation.

FREDERICK EMERSON,
Author of the North American Arithmetic.

I heartily concur in the above recommendation.

WM. B. FOWLE,
Late Teacher of the Female Monitorial School, Boston.

BOSTON, OCT. 23, 1843.

MR. AARON PALMER—

Sir: Your "Self-Computing Scale" appears to me an exceedingly useful invention. I shall be glad to possess one of them, as it will save me much labor; and I doubt not that many persons will find the same advantage in its use.

Respectfully your servant,
JOHN S. TYLER,
Notary Public and Insurance Broker.

Boston, Oct. 24, 1843.

I have examined Mr. Aaron Palmer's "Self-Computing Scale;" it strikes me as being a very convenient labor-saving machine, and that it will be highly useful in calculating interest, general average, or dividends on a bankrupt's estate, and for other similar purposes.

S. E. SEWELL, *Counsellor at Law.*

I have examined "The Endless Self-Computing Scale" of Mr. Palmer, and with pleasure express my high admiration of it. It is constructed on the only principle acknowledged by scientific men, since the invention of logarithms, adequate to such purposes. Over all sliding logarithmic scales it possesses a vast superiority, both in facility of use, and accuracy of result. For this superiority it is indebted to its circular form. With a diameter of about eight inches, it is equivalent to a common sliding scale of four feet, with its slide of the same length, making, when drawn out, a rod of about eight feet in length. It will be seen that its accuracy will be proportionably greater, as a circle can be constructed more exact than such a scale.

G. C. WHITLOCK,
Professor of Mathematics and Natural Science in Genesee Wesleyan Seminary.

Mr. Aaron Palmer—

Sir: I have taken much pleasure in testing the power of your "Self-Computing Scale," by examples from nearly all the arithmetical rules. I am particularly struck with its great facility and accuracy in computing interest, apportioning dividends, and performing proportions generally. From the best examination I have been able to give it, I think it at once a most simple and wonderful invention; and I am confident, that when perfected, it will come rapidly into extensive public use, and will prove of singular benefit to those having occasion to make frequent computations in bankruptcy, insolvency, insurance, averages, taxation, and the like branches of business.

AMOS B. MERRILL,
10 *Court-street, Boston.*

PREFACE.

At the suggestion of several intelligent friends who have become acquainted with my "*Computing Scale*," I have been induced to present this simple volume to the public. The general *principle* on which my Scales are constructed, is now acknowledged by all scientific men, as the only one adequate to perform computations mechanically. The rapidity, certainty, and accuracy of their results are now established beyond the possibility of a doubt. The present volume can be afforded at a price which will place it within the reach of all. Those who wish to carry out their computations to a greater number of decimals, can have their wishes gratified in the purchase of "*Palmer's Computing Scale*," which is nearly one foot square. All the errors which have been discovered in the former editions, have been corrected in this; and the present work may be regarded as nearly perfect. I only ask a candid examination of the work, and hope it may be as useful to the public, as I have, by long and arduous labor, sought to make it.

AARON PALMER.

Boston, Feb. 15, 1844.

DESCRIPTION OF THE SCALE.

THE lines on both parts of the Scale are precisely alike. That part of the Scale which revolves is called "*the circular*," and the other is called the "*fixed part.*" The lines represent the exact position of the different figures, and are generally numbered. The longest lines are numbered 1, 2, 3, &c., and represent 1, 2, 3, &c., or 10, 20, 30, &c., or 100, 200, 300, &c., or $\frac{1}{10}$, $\frac{2}{10}$, $\frac{3}{10}$, &c., according to the nature of the problem to be solved. The next sized lines represent 11, 12, 13, 21, 54, &c., or 110, 120, &c., and are nearly all numbered. The shortest lines represent the amount or quantity, when it is composed of three figures, as, 101, 102, 125, &c., or 10·1, 12·5, &c., or 1·01, 1·25, &c.; but on the Pocket Scale these lines are not numbered.

To find 105 *on the Pocket Scale.*—Call the large 1, 100; then count five of the short lines toward 11, and you have the point for 105.

To find 224.—First find 22, (the two first figures in the amount,) then count the short lines between 22 and 23; the first short line represents 223; the next short line is 224.

To find 645.—First find 64, (the two first figures in the amount,) then the only short line between 64 and 65 represents 645.

A TABLE OF GAUGE-POINTS USED ON THIS SCALE.

I., at the diamond, is the gauge-point for Multiplication, Division, &c., &c.

A. Area of a Circle.

C. Circumference of a Circle.

B. G. Beer Gallons.

W. G. Wine Gallons.

15. For months, at 8 per cent.

1714. For months, at 7 per cent.

2. For months, at 6 per cent.

456 . For days, at 8 per cent.

521. For days, at 7 per cent.

608. For days, at 6 per cent.

107. Compound Interest for years, at 7 per cent.

106. Do. do. do. 6 do.

160. For Acres.

144. For Square Timber.

9. Yards Square.

886. Square and Circle, equal in Area.

707. Inscribed Square.

577. Side of Inscribed Cube.

87. Side of Inscribed Triangle.

589. Side of Pentagon, (5 sides.)

5. Side of Hexagon, (6 sides.)

437. Side of Heptagon, (7 sides.)

383. Side of Octagon, (8 sides.)
337. Side of Nonagon, (9 sides.)
31. Side of Decagon, (10 sides.)
282. Side of Undecagon, (11 sides.)
26. Side of Dodecagon, (12 sides.)
464. Diameter of 3 Inscribed Circles.
416. Diameter of 4 Inscribed Circles.
785 . Point for Area.
314 . Point for Circumference.

TO PERFORM MULTIPLICATION.

Rule.—First find the multiplier on the circular. Place it opposite 1; then opposite the multiplicand found on the fixed part, is the product on the circular.

Example.—What is the product of 4 by 2?

Place 2 opposite 1; then opposite 4 is the product = 8.

N. B.—Observe, now, that all the numbers and parts of numbers on the fixed part, are multiplied by 2, and their products are directly opposite them on the circular. So of any other multiplier.

What is the product of 12 by 7?

Place 7 opposite 1; then opposite 12 is 84, the answer.

Of 3 by 3?

Place 3 opposite 1; then opposite 3 is 9, the answer.

What is the product of 8 by $2\frac{1}{2}$?

Place 2·5 opposite 1; then opposite 8 is 20, the answer.

What is the product of 10 by 5?

Place 5 opposite 1; then opposite 10 is 50, the

answer. Here you have to use the same figures both times, calling them 1 and 5 the first time, and adding a cipher to each the next time.

What is the product of 13 by 3 ?

Place 3 opposite 1; then opposite 13 (found between the large 1 and 2) is 39, the answer.

What is the product of 50 by 4 ?

Place 4 opposite 1: now we must call the large 5, 50: opposite it is 200, the answer.

What is the product of 24 by 3 ?

Place 3 opposite 1; then opposite 24 (found between the large 2 and the large 3) is 72, the answer.

What is the product of 3 multiplied by ·2, (two tenths ?)

Now we must call the large 2 two tenths. Place it opposite 1; then opposite 3 is ·6, (six tenths,) the answer.

DIVISION.

Rule.—Find the divisor on the circular. Place it opposite 1; then opposite the dividend, found also on the circular, is the quotient on the fixed part.

Example.—2 is in 8, how many times ?

Place 2 opposite 1; then opposite 8 is 4, the answer.

3 is in 12, how many times?

Place 3 opposite 1; then opposite 12 is 4, the answer.

How many times 4 in 14?

Place 4 opposite 1; then opposite 14 is 3 and five tenths, (3·5,) the answer.

NOTE.—Whenever a divisor is placed opposite 1, all the numbers and parts of numbers on the circular are divided by it. The quotients are on the fixed part.

Example.—Place the divisor 2 opposite 1; now opposite 2 is 1, opposite 12 is 6, opposite 4 is 2, opposite 6 is 3, opposite 14 is 7, opposite 24 is 12, opposite 125 is 62·5, opposite 75 is 37·5, &c.

TO MULTIPLY BY ONE NUMBER, AND DIVIDE BY ANOTHER, BY ONE SIMPLE PROCESS.

RULE.—Place the multiplier on the circular opposite the divisor; then opposite the multiplicand is the result.

Example.—What is the result of 22 multiplied by 13, and divided by 14?

Place 13 opposite 14; then opposite 22 is 20·4+, the answer.

FRACTIONS.

TO CHANGE AN IMPROPER FRACTION TO A WHOLE OR MIXED NUMBER.

RULE.—Place the numerator found on the cir-

cular opposite the denominator; then opposite 1 is the answer.

Example.—A man spending $\frac{1}{6}$ of a dollar per day, in 8 days would spend $\frac{8}{6}$ of a dollar. How much would that be?

Place 8 opposite 6; then opposite 1 is $1.33, the answer.

In $\frac{8}{4}$ of a dollar how many dollars?

Place 8 opposite 4; then opposite 1 is $2, the answer.

To reduce a Mixed Number to an Improper Fraction.

Rule.—Place the mixed number opposite 1; then opposite the denomination to which you wish it reduced, is the answer.

Example.—In $16\frac{5}{12}$ of a dollar, how many 12ths of a dollar?

Place $16\frac{5}{12}$ opposite 1; then opposite 12 is the number of 12ths in $16\frac{5}{12}$, viz., $197 = \frac{197}{12}$, the answer.

To reduce a Fraction to its Lowest and all its Terms.

Rule.—Place the numerator found on the circular, opposite the denominator; then all the numbers standing directly opposite each other, are other terms of said fraction; and the lowest of said numbers are its lowest terms.

Reduce $\frac{12}{16}$ to its lowest terms.

Place 12 opposite 16; now 9 is opposite 12, ($\frac{9}{12}$,) 6 is opposite 8, ($\frac{6}{8}$,) and 3 is opposite 4, ($\frac{3}{4}$,) the answer.

To divide a Fraction by a Whole Number.

Rule.—Place the whole number, found on the circular, opposite 1; then opposite the denominator is a number, which, placed opposite the numerator, is the answer.

Example.—If 2 yards of cloth cost $\frac{2}{3}$ of a dollar, how much is that per yard?

2 is in $\frac{2}{3}$ how many times? Place 2 opposite 1; then opposite 3 is 6. Now place this opposite 2, and it will read $\frac{2}{6}$, the answer, $= \frac{1}{3}$.

2 is in $\frac{7}{8}$ how many times?

Place 2 opposite 1; opposite 8 is 16. This, placed opposite 7, makes $\frac{7}{16}$, the answer.

To multiply a Whole Number by a Fraction, or a Fraction by a Whole Number.

Rule.—Place the numerator found on the circular, opposite the denominator; then opposite the whole number is the answer.

N. B.—Whenever a numerator is placed opposite a denominator, all the numbers on the circular are that fractional part of the numbers opposite them.

Example.—Place 3 opposite 4; this is $\frac{3}{4}$. Now the 3 is $\frac{3}{4}$ of 4; 6 stands opposite 8, being $\frac{3}{4}$ of 8; 9 is opposite 12; 12 is opposite 16; &c., &c. Now move the circular until 3 is opposite 5; now all the numbers on the circular are $\frac{3}{5}$ of those opposite them.

Note.—Whenever a numerator is placed opposite a denominator, thereby forming a vulgar fraction, the decimal of said vulgar fraction is opposite 1; hence,

To reduce Vulgar Fractions to Decimal Fractions.

Rule.—Place the numerator found on the circular, opposite the denominator; then opposite 1 is the decimal fraction.

Example.—What is the decimal of $\frac{3}{4}$?

Place 3 opposite 4; now opposite 1 is ·75, the answer.

What is the decimal of $\frac{7}{8}$?

Place 7 opposite 8; opposite 1 is ·875.

To reduce Decimal Fractions to Vulgar Fractions.

Rule.—Place the decimal, found on the circular, opposite 1; then any two figures standing directly opposite each other, is the answer.

Example.—What is the vulgar fraction equivalent to the decimal ·5?

Place 5 opposite 1; now 1 is opposite $2 = \frac{1}{2}$, the answer.

To multiply one Fraction by another.

Rule.—Reduce one to decimals; then the numerator of the other opposite the denominator: then opposite the decimal is the answer in decimals, which, if desired, can be reduced to a vulgar fraction by the preceding rules.

To reduce the different Currencies to Federal Money.

Rule.—Place the 1 *on the circular*, opposite the number of shillings and parts of a shilling composing a dollar of the currency to be reduced; then opposite the given number of shillings is the answer.

Example.—Reduce 5 shillings, New York currency, to Federal money.

Place 1 (on the circular) opposite 8; then opposite 5 shillings is ·625, the answer.

In 15 shillings, how much?

Opposite 15 is 1·875, the answer.

In 32 shillings, English currency, how much?

Place 1 (on the circular) opposite 4·5; then opposite 32 is $7·11, the answer.

In 9 shillings, how much?

Opposite 9 is $2, the answer.

INTEREST.

To compute Interest for Years.

Rule.—Place the rate per cent. found on the circular, opposite 1; then opposite the principal is the interest.

Example.—What is the interest of $50, at 7 per cent.?

Place 7 opposite 1; then opposite 50 is $3·50, the answer.

What is the interest on $40, at $6\frac{1}{2}$ per cent.?

Place 6·5 opposite 1; then opposite 40 is $2·60, the answer.

To compute Interest for Months.

Rule.—Place the principal (found on the circular) opposite the gauge-point for months, at the given per cent.; then opposite the given number of months is the answer.

Example.—What is the interest on $50 for three months, at 7 per cent.?

Place 50 (found on the circular) opposite 1714; (the gauge-point for months, at 7 per cent.;) then opposite 3 months is ·875, the answer.

What is the interest on $60 for eight months, at 6 per cent.?

Place 60 opposite ·2, (the gauge-point for months, at 6 per cent.;) then opposite 8 months is \$2·40, the answer.

To compute Interest for Days.

Rule.—Place the principal (found on the circular) opposite the gauge-point for days at the given per cent.; then opposite the number of days is the answer.

Example.—What is the interest on \$55 for 15 days, at 6 per cent.?

Place 55 opposite ·608, (the gauge-point for days, at 6 per cent.;) then opposite 15 days is ·135, (thirteen cents and five mills,) the answer.

The Principal and Interest being given, to find the rate per cent.

Rule for one Year.—Place the interest opposite the principal; then opposite 1 is the rate per cent.

Example.—Received \$7·00 for the use of \$50·00 for one year: what was the rate per cent.?

Place 7 opposite 50; then opposite 1 is 14, the answer, (14 per cent.)

Gave \$4·00 for the use of \$80·00 one year: what was the rate per cent.?

Place 4 opposite 80; then opposite 1 is 5, the answer, (5 per cent.)

Rule for Months.—Place the given interest opposite the given number of months; then observe the number opposite 12. Now place this number opposite the principal; then opposite 1 is the rate per cent.

Example.—Paid 25 cents for the use of $5·00 for 4 months: what was the rate per cent.?

Place 25 opposite 4; then opposite 12 is 75. Now place 75 opposite $5·00; then opposite 1 is 15, (15 per cent.,) the answer.

Gave 14 cents for the use of $60·00 one month: what was the rate per cent.?

Place 14 opposite 1; then opposite 12 is 1·68. Now place 1·68 opposite 60; then opposite 1 is 2·8, ($2\frac{8}{10}$ per cent.,) the answer.

Rule for Days.—Place the given interest opposite the given number of days; then observe the interest opposite 365, (the number of days in a year.) Place this opposite the principal; then opposite 1 is the rate per cent.

Example.—Paid 14 cents for the use of $64·00 for 29 days: what was the rate per cent.?

Place 14 opposite 29: now opposite 365 is $1·76. Now place 1·76 opposite 64; then opposite 1 is 2·75, ($2\frac{3}{4}$ per cent.,) the answer.

Paid 23 cents for the use of $50·00, for 21 days: what was the rate per cent.?

Place 23 opposite 21: now opposite 365 is 4. Place 4 opposite 50; then opposite 1 is 8 per cent., the answer.

The Rate per cent. and the Interest being given, to find the Principal.

Rule for one Year.—Place the rate per cent. opposite 1; then opposite the interest is the principal.

Example.—At 7 per cent. I paid \$3·50 for the use of money 1 year: what was the principal?

Place 7 opposite 1; then opposite 3·50 is \$50·00, the answer.

Rule for Months.—Place the interest opposite the given number of months; then opposite the point of the given per cent. for months, is the answer.

Example.—Gave \$2·00 at 7 per cent. for three months: what was the principal?

Place 2 opposite 3; then opposite 1·714 is \$114·30, the answer.

Rule for Days.—Place the given interest opposite the given number of days; then opposite the gauge-point for days stands the principal.

Example.—At 7 per cent., gave 15 cents for 20 days: what was the principal?

Place 15 opposite 20; then opposite 521 (the gauge-point for days, at 7 per cent.) is \$39·00, the answer.

The Rate per cent., Interest, and Principal being given, to find the Time.

Rule.—Place the interest of the given principal for one year, opposite 12; then opposite the given interest will be the answer, in months and decimals of a month. Or, place the interest of the given principal for one year opposite 365; then opposite the given interest will be the time in days.

Example.—Gave 87·5 cents, at 7 per cent., fc $50·00: how long did I have it?

The interest of $50·00 for one year is $3·50. Place 3·50 opposite 12; then opposite ·875 is the answer, 3 months.

Gave 24 cents, at 7 per cent., for the use of $50·00: how long did I have it?

Place $3·50 opposite 365; then opposite 24 is the answer, 25 days.

Compound Interest.

Rule.—Place the principal opposite fig. 1; then ›pposite the rate per cent. added to 100, on the fixed part, is the amount for one year. Place this amount opposite fig. 1; then opposite the same point is the amount for two years. Place this last amount opposite 1; then opposite the same point is the amount for three years, &c.

Example.—What is the compound interest on \$5·00 for 5 years, at 6 per cent.?

Place 5 opposite 1; then opposite 106 (the per cent. added to 100) is \$5·30, the amount for 1 year. Now place \$5·30 opposite 1; then opposite 106 is \$5·62, the amount for 2 years. Now place \$5·62 opposite fig. 1; then opposite 106 is \$5·95, the amount for 3 years. Now place \$5·95 opposite fig. 1; then opposite 106 is \$6·31, the amount for 4 years. Now place \$6·31 opposite fig. 1; then opposite 106 is \$6·69, the amount for 5 years.

LOSS AND GAIN.

Bought a hogshead of molasses for \$60: for how much must I sell it to gain 20 per cent.?

Rule.—Place 20 opposite 1; then opposite 60 is what must be added to the original cost to gain said per cent., viz. 12; which added to 60=72.

Bought cloth at \$2·50 per yard; but, being damaged, I am willing to sell it so as to lose 12 per cent. How must I sell it per yard?

Place 12 opposite 1; then opposite \$2·50 is ·30, the amount to be deducted from \$2·50, which will leave 2·20, the answer.

Bought cloth at 50 cents per yard; sold it for 10 cents advance from cost. What per cent. did I make?

Place 10 opposite 50; then opposite 1 is 20 per cent., the answer.

Another Method.—Place the original cost opposite 1; then opposite the rate per cent. added to 100, is the answer.

Example.—Bought corn at 50 cents per bushel: at how much must I sell it to gain 20 per cent.?

Place 50 opposite 1; then opposite 120 is 60 cents, the answer.

Bought cloth at $2 per yard, and sold it at $3 per yard: what per cent. did I make?

Place 2 opposite 1; then opposite 3 is 150, 50 per cent., answer.

RULE OF THREE, OR PROPORTION.

Rule.—Place the second term opposite the first; then opposite the third term is the answer.

Example.—If 2 yards of cloth cost $4·00, what cost 8 yards?

Place 4 opposite 2; then opposite 8 is 16.

Note.—All numbers of yards, at that rate, are now on the scale, and may be determined without moving the circular.

At $\frac{7}{8}$ of a dollar per yard, what cost 4 yards?

Place 7 opposite 8; then opposite the given number of yards, is the answer.

If 1 ton of hay cost $8·00, what cost 900 pounds?

Place 8 opposite 2000, (the number of lbs. in a ton;) then opposite 900 is the answer: and so of any other number of pounds.

FELLOWSHIP.

Rule.—Place the whole gain or loss opposite the whole stock; then opposite each man's share of the stock, is his share of the gain or loss.

Example.—A invested $30, B invested $20, and they gained in trade $12: what is each one's share of the gain?

Place 12 (the whole gain) opposite 50, (the whole stock;) then opposite 20 (A's stock) is $4·80, and opposite 30 (B's stock) is $7·20.

EVOLUTION.

To extract the Square Root.

Rule.—Move the given number around until it is opposite the same number which is opposite 1; and that number is the answer sought.

Example.—What is the square root of 42?

Move 42 on the circular around until it comes opposite 6·48. Now 6·48 is opposite 1; hence that is the square root of 42.

To extract the Cube Root.

Rule.—Move the given number around until it

comes opposite a number, the square of which at the same time is opposite 1; and that number is the root sought.

Example.—What is the cube root of 27?

Move 27 around until it comes opposite 3; at that time 9 is opposite 1; hence 3 is the answer.

TO APPORTION TAXES.

Rule.—Place the whole tax to be raised, found on the circular, opposite the whole valuation; then opposite each man's valuation, is his tax.

Example.—A tax of $1.500·00 is levied on a valuation of $200.000·00: what is a man's tax whose valuation is $700·00?

Place 1500 opposite 200.000; then opposite 700 is $5·25, the answer.

School Tax.

1550 days have been sent, and $33·20 tax is to be raised: how much is each man's tax?

Place 33·20 opposite 1550; then opposite the days each man has sent, is his tax.

A has sent 28 days; his tax is 60 cents.

Opposite 70, the number of days B has sent, is his tax, $1·50; and so of every other man's tax, without moving the scale.

TO COMPUTE TOLL.

What is the toll on 6000 pounds, for 289 miles, at 4 mills per mile per 1000 pounds ?

Place the 4 opposite 1000 ; opposite 6 is ·024, (two cents four mills.) Now place this opposite 1 ; then opposite 289 is $6·936, the answer.

TO MEASURE SUPERFICES.

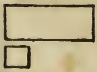
Rule 1.—Place the width in inches opposite 12 ; then opposite the feet in length is the answer, in feet and tenths of a foot.

Example.—Give the contents of a board 6 inches wide, 14 feet long.

Place 6 opposite 12 ; then opposite 14 (the length) is the answer, 7 feet.

Rule 2.—Place the width in feet opposite 1 ; then opposite the length in feet, is the answer in feet.

How many square feet in a floor 20 by 20 ?
$20 \times 20 = 400$, the answer.



How many square feet in a garden 96 by 54 feet ?
$96 \times 54 = 5184$ feet, the answer.

Note.—If one side be inches, and the other feet, place the given number of inches opposite the number of inches

in a foot, viz. 12; then opposite the length in feet will be the answer in feet. If one side be feet, and the other rods, the answer will be in rods, by placing the feet opposite the number of feet in a rod, &c., &c.

In a lot of land 120 rods long and 60 rods wide, how many acres?

Place 60 opposite 160, (the number of rods in an acre;) then opposite 120 is 45 acres, the answer.

If a board be 8 inches wide, how much in length will make a square foot?

Place the width, 8 inches, opposite 1; then opposite 144 (the number of square inches in a foot) is the answer, 18 inches.

If a piece of land be 5 rods wide, how many rods in length will make an acre?

Place 5 opposite 1; then opposite 160 (the number of rods in an acre) is the answer, 32 rods.

Square Yards.

How many square yards of carpeting will it require to cover a floor 20 feet long and 14 feet wide?

Place 20, found on the circular, opposite 9, (the gauge-point for yards square;) then opposite 14, on the fixed part, is 31 yards, the answer.

The Width and Contents given, to find the Length.

Rule.—Place the contents on the circular, op-

posite the width in feet; then opposite 9, on the fixed part, is the length in feet.

Example.—I have a room containing 20 square yards; I wish to cover it with a piece of carpeting $2\frac{1}{2}$ feet wide: how many feet in length will it require?

Place 20 on the circular opposite 2·5, ($2\frac{1}{2}$;) then opposite 9, on the fixed part, is 72 feet, the answer.

To measure Land in Chains and Links.

Rule.—Place one of the sides, in chains and links, opposite 1; then opposite the other side, in chains and links, is the number of acres and parts of an acre.

Example.—To find the acres in 7 chains and 50 links by 6 chains and 40 links.

Place 750 opposite 1; then opposite 640 is 4·80 ($4\frac{80}{100}$) acres, the answer.

To find the acres in 7 chains and 75 links by 9 chains and 64 links.

Place 775 opposite 1; then opposite 964 is $7\frac{47}{100}$ acres, the answer.

To find the amount of land in 1 chain and 80 links by 2 chains and 50 links.

Place 180 opposite 1; then opposite 250 is ·45 ($\frac{45}{100}$) of an acre, the answer.

To measure Square Timber.

Rule.—Place the product of the width by the thickness, opposite 144; then opposite the length is the answer in feet and tenths.

Example.—What is the solid contents of a stick 4 inches by 7, and 20 feet long?

$4 \times 7 = 28$. Place 28 opposite 144; then opposite the length, 20 feet, is 3·9 feet, the answer, $=3\frac{9}{10}$ feet.

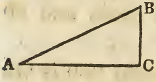
What is the solid contents of a stick of timber 18 inches by 18 inches, and 13 feet long?

The product of 18 by 18, is 324. Now place 324 opposite 144; then opposite 13 (the length) is 29·3, ($29\frac{3}{10}$,) the answer.

N. B.—If it be desired to have the answer in inches, instead of placing the product of the width by the thickness, opposite 144, place it opposite 1; then opposite the length in inches, will be the solid contents in inches.

Note.—Any bale, box, or chest may be measured by the preceding rule.

To measure a Hypotenuse.



AB ***hypotenuse,*** **BC** ***perpendicular,*** **AC** ***base.***

Rule.—Square each of the sides, and add their

products together, the square root of which is the answer.

Example.—What is the hypotenuse of a right-angled triangle, one side of which is 3 feet, the other 4 feet?

$3\times3=9$, and $4\times4=16$; these two added together make 25, the square root of which is 5 feet, the answer.

To measure a Triangle.

Place half the base opposite 1; then opposite the perpendicular height, is the area.

Example.—What is the area of a triangle whose base is 32 inches, and perpendicular height 14 inches?

Place 16 ($\frac{1}{2}$ of 32) opposite 1; then opposite 14 is 224 square inches, the answer.

To find the Solid Contents of a Pyramid.

Rule.—Multiply the area of the base by $\frac{1}{3}$ of the perpendicular height, whether it be a square, triangular, or circular pyramid.

Example.—What is the solid contents of a pyramid whose base is 4 feet square, and perpendicular height 9 feet?

$4\times4=16$, the base. Place this opposite 1. Now $\frac{1}{3}$ of 9 is 3. Opposite 3 is the solid contents, 48 feet.

There is a cone whose height is 27 feet, and whose base is 7 feet in diameter: what are its contents?

Place the square of 7 (49) opposite 1; then opposite A is the area of the base.

$\frac{1}{3}$ of 27 is 9. Place 9 opposite 1; then opposite the area (38·6) is the answer, $346\frac{1}{2}$ solid feet.

To find the Solid Contents of a Frustum of a Pyramid.

Rule.—To the product of one end by the other, add the sum of the squares of each end. Place this opposite 144. Then opposite $\frac{1}{3}$ of the length, is the answer.

Example.—What are the contents of a stick of timber whose larger end is 12, whose smaller end is 8 inches, and whose length is 30 feet?

The product of one end by the other is 96, the square of 12 is 144, the square of 8 is 64. These, all added, make

$$\begin{array}{r} 96 \\ 144 \\ 64 \\ \hline 304. \end{array}$$

Place this opposite 144; then opposite 10 ($\frac{1}{3}$ of the length) is the answer, $21\frac{1}{9}$ feet.

To find the Solid Contents of a Frustum of a Cone.

Rule.—Multiply each diameter by itself separately; multiply one diameter by the other; add these three products together. Now place the length opposite 382; then opposite the products thus added, is the answer.

To find the Circumference of a Circle from its Diameter, or its Diameter from its Circumference.

Rule.—Place letter c (found on the circular) opposite fig. 1; then the figures on the fixed part are diameters, and those on the circle are circumferences. Opposite each diameter is its circumference.

Example.—What is the circumference of a circle whose diameter is 9 inches?

Place c opposite fig. 1; then opposite 9 is 28·2, (28 inches and 2 tenths,) the answer.

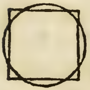
To find the Area of a Circle.

Rule.—Place the square of the diameter opposite 1; then opposite the letter a is the area.

Example.—What is the area of a circular garden whose diameter is 11 rods?

Place 121 (the square of 11) opposite 1; then opposite the letter a is 95·03 rods, the answer.

To find the side of a Square equal in area to any given Circle.

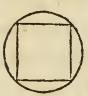


Rule.—Place '886, found on the circular, opposite fig. 1; then opposite any diameter of a circle upon the fixed part, is the side of a square equal in area, on the circular.

Example.—What is the side of a square equal in area to a circle 4 feet in diameter?

Place '886 opposite fig. 1; then opposite 4 is 3·55 feet, the answer.

To find the side of the greatest Square that can be inscribed in any given Circle.



Rule.—Place '707, found on the circular, opposite fig. 1; then opposite any diameter of a circle, (found on the fixed part,) is the side of its inscribed square.

Example.—What is the side of an inscribed square equal in area to a circle 45 rods in diameter?

Place '707 opposite fig. 1; then opposite 45, on the fixed part, is 31·8 rods, the answer.

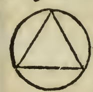
To find the length of one side of the greatest Cube that can be taken from a Globe of a given diameter.

Rule.—Place 577, found on the circular, opposite fig. 1; then opposite any diameter, on the fixed part, is the length of one side of the greatest cube.

Example.—What is the length of the side of the greatest cube that can be taken from a globe 82 inches in diameter?

Place 577 (the gauge-point for the side of an inscribed cube) opposite fig. 1; then opposite 82, on the fixed part, is 47·3 ($47\frac{3}{10}$) inches, the answer.

To find the length of the side of the greatest equilateral triangle that can be inscribed in a given circle.



RULE.—Place 87, found on the circular, opposite fig. 1; then opposite any diameter on the fixed part, is the length of the side of an inscribed triangle. And opposite the length of the side of any triangle, on the circular, is the diameter required to inscribe it in.

Example.—What is the length of one side of the greatest equilateral triangle that can be inscribed in a circle 62 inches in diameter?

Place 87 opposite fig. 1; then opposite 62, on the fixed part, is 54 inches, the answer.

What is the least diameter of a circle in which a triangle may be inscribed, whose side is 6·5 inches, ($6\frac{1}{2}$)?

Place 87 opposite fig. 1; then opposite 6·5, on the circular, is 7·48 ($7\frac{48}{100}$) inches, the answer.

To find the length of the side of the greatest figure that can be inscribed in a given Circle.

RULE.—For a

Pentagon	(5 sides)		Place	589.
Hexagon	6	"	"	5.
Heptagon	7	"	"	437.
Octagon	8	"	"	3·83
Nonagon	9	"	"	337
Decagon	10	"	"	31
Undecagon	11	"	"	282
Dodecagon	12	"	"	26

opposite fig. 1; then opposite any given diameter on the fixed part, is the length of the side of the greatest figure that can be inscribed in it.

Example 1.—What is the length of one side of the greatest pentagon, or five-sided figure, that can be inscribed in a circle whose diameter is 51 inches?

Place 589 opposite 1; then opposite 51, on the fixed part, is 30 inches, the answer.

Example 2.—What is the length of one side of the greatest nonagon (*nine-sided* figure) that can be inscribed in a circle 82 feet in diameter?

Place 337 opposite fig. 1; then opposite 82, found on the fixed part, is 27·6 ($27\frac{6}{10}$) feet, the answer.

Example 3.—What is the least diameter of a circle in which may be inscribed an undecagon,

(eleven-sided figure,) one side of which is 13 inches long?

Place 282 opposite fig. 1; then opposite 13 inches, found on the circular, is 46·1 inches, the answer.

To find the greatest diameter of each of three equal Circles that can be inscribed within a Circle of a given diameter.

Rule.—Place 464 opposite fig. 1; then opposite any diameter on the fixed part is the diameter of one of the three inscribed circles.

Example.—What is the greatest diameter of each of three circles, that can be inscribed within a circle 25 inches in diameter?

Place 464 opposite fig. 1; then opposite 25 on the fixed part, is 11·6 inches, the answer.

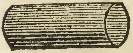
To find the greatest diameter of four equal Circles that can be inscribed within another Circle of a given diameter.

Rule.—Place 416 opposite fig. 1; then opposite any given diameter on the fixed part, is the diameter of each of the four inscribed circles.

Example.—What is the greatest diameter of each of four equal circles, that can be inscribed in another circle 22 inches in diameter?

Place 416 opposite fig. 1; then opposite 22, on the fixed part, is 9·15 ($9\frac{15}{100}$) inches, the answer.

To find the solidity of a Cylinder, or to measure Round Timber.



Rule.—First find the area of the base by the rule for finding the area of a circle; place that area opposite 144; then opposite the length in feet is the answer, in feet and decimals of a foot.

Note.—If the diameter be given in feet, place the area opposite 1, instead of placing it opposite 144.

Example.—What are the solid contents of a cylinder 5 inches in diameter, and 13 feet long?

Place 25 (the square of 5) opposite 1; then opposite A is 1·965. Now place 1·965 opposite 144; then opposite 13 (the length) is 1·77 feet, the answer.

How many solid feet in a round log 15 inches in diameter, and 14 feet long?

Place 225 (the square of 15) opposite 1; then opposite A is 1·77, the area. Now place 1·77 opposite 144; then opposite 14 is 17·2 feet, the answer.

In a log 12 feet long, 14 inches diameter? Answer, 12·8 feet.

In a log 16 feet long, 11 inches in diameter? Answer, 10·5 feet.

In a log 7 inches diameter, 15 feet long? Answer, $4\frac{2}{100}$ feet.

NOTE.—If the diameter and length are both given in inches, place the square of the diameter opposite 1728; then opposite the inches in length is the answer in feet.

NOTE.—A cylinder that is 12 inches in diameter and 12 inches long, and a globe that is 12 inches in diameter, and a cone that is 12 inches high and 12 inches diameter at its base, bear a proportion to each other as 3, 2, and 1. Therefore, if you place the contents of any cylinder on the circular opposite to 3 on the fixed part, then opposite 2 on the fixed part is the contents of an inscribed globe, and opposite fig. 1 is the contents of an inscribed cone.

To find how many solid feet a round stick of Timber will contain, when hewn square.

RULE.—Place double the square of half the diameter opposite 144; then opposite the length is the answer.

Example.—In a log 28 feet long, 22 inches diameter, half the diameter is 11, the square of which is 121. This doubled, is 242. Now place 242 opposite 144; then opposite 28 (the length) is 47 + the answer.

To find how many feet of Boards can be sawn from a Log of given diameter.

RULE.—Find the solid contents of the log when

made square ; then place 12 opposite the thickness of the board, (including the saw-calf ;) then opposite the solid contents is the answer in feet.

To find the Area of a Globe or Ball.

RULE.—Place the diameter opposite 1 ; then opposite the circumference is the answer.

Example.—How many square inches of leather will cover a ball $3\frac{1}{2}$ inches in diameter ?

Place $3\frac{1}{2}$ opposite 1 ; then opposite D. is 11, the circumference. Opposite 11 is the area, $38\frac{1}{2}$ inches.

How many square feet on the surface of a globe 4 feet in diameter ?

Place 4 opposite 1 ; then opposite D. is 12·55 feet, the circumference. Opposite 12·55 is 50·4, the answer.

To find the solid contents of a Globe or Ball.

RULE.—First find its area by the preceding rules ; then multiply its area by $\frac{1}{6}$ of its diameter.

Example.—What are the solid contents of a ball 14 inches in diameter ?

Place 14 opposite 1 ; then opposite D. is 44 inches, the circumference. Opposite 44 is 617, the area. $\frac{1}{6}$ of the diameter is $2{\cdot}33\frac{1}{3}$. Place this op-

posite 1; then opposite 617 (the area) is 1437 inches, the solid contents.

What are the solid contents of a ball 5 inches in diameter?

Place 5 opposite 1; then opposite D. is 15·7 inches, the circumference. Also, opposite 15·7 inches is 78·4 inches, the area. $\frac{1}{6}$ of 5 is ·835. Place this opposite 1; then opposite 78·4 inches (the area) is 654 inches, the solid contents.

There is a ball 20 inches in circumference: what are its solid contents?

Place 20 opposite letter D. Opposite 20 is 127, the area. $\frac{1}{6}$ of the diameter is 1·06. Place this opposite 1; then opposite 127 is 1350 inches, the solid contents.

To find the Area of an Ellipse.

RULE.—Place the product of the transverse diameter multiplied by the conjugate diameter, opposite 1; then opposite letter A is the answer.

Example.—What is the area of an ellipse whose transverse diameter is 12 inches, and conjugate diameter 10 inches?

$10 \times 12 = 120$. Place 120 opposite 1; then opposite letter A is 94·25, the area.

Gauging Casks.

To find the mean Diameter of a Cask.

Rule.—Add $\frac{2}{3}$ of the *difference* between the head and bung diameter, to the head diameter. This reduces the cask to a cylinder. Then multiply the square of the *mean diameter* by the length. Place the product opposite 1; then opposite BG is the number of beer gallons, and under WG is the number of wine gallons.

Example.—There is a cask whose head diameter is 25 inches, bung diameter 31 inches, and whose length is 36 inches: how many beer gallons and how many wine gallons does it contain?

6 is the difference between 25 and 31. $\frac{2}{3}$ of 6 is 4. This added to 25 makes 29 inches, the mean diameter. The square of 29 is 841. Place this opposite 1; then opposite 36 is 302+. Place this last opposite 1; then opposite BG is 85 gallons, and opposite WG is 103 gallons, the answer.

To find the Weight of an Iron Ball from its Diameter.

Rule.—Place the cube of the diameter opposite 1; then opposite 14 is the weight.

Example.—What is the weight of an iron ball 6·7 inches in diameter?

$6 \cdot 7 \times 6 \cdot 7 = 45$, and $45 \times 6 \cdot 7 = 301 \cdot 5$. Place **301·5** opposite 1; then opposite 14 is 42·29 pounds, the answer.

A ball 5·54 inches diameter?

Answer, 24 pounds nearly.

A ball 32 inches circumference?

Place 32 opposite D; then opposite 1 is the diameter. Now cube the diameter, and place that cube opposite 1; then opposite 14 is 148 pounds, the answer.

To find the Weight of a Leaden Ball from its Diameter or Circumference.

RULE.—Place the cube of the diameter opposite 1; then opposite 21·5 is the weight.

A ball is 6·6 inches in diameter: what is its weight?

Answer, 61·6 pounds.

A ball 5·3 inches in diameter?

Answer, 32 pounds nearly.

To find the Diameter of an Iron Ball from its Weight.

RULE.—Place the weight opposite 1; then opposite 7·11 is a product, the cube root of which is its diameter.

What is the diameter of a 24 pound ball? Answer, 5·54 inches.

To find the Diameter of a Leaden Ball from its Weight.

RULE.—Place 14 opposite 3; then opposite the weight is a product, the cube root of which is the answer.

A ball 8 pounds in weight is 3·34 inches in diameter.

Specific Gravity and Weight of Bodies.

	oz.		oz.
Pure Platina, . .	23000	Clay, ...	2160
Fine Gold, . .	19400	Brick, ...	2000
Standard Gold, .	17720	Common Earth, .	1984
Quicksilver, . .	13600	Nitre, ...	1900
Lead, ...	11325	Ivory, ...	1825
Fine Silver, . .	11091	Brimstone, . .	1810
Common Silver, .	10535	Solid Gunpowder,	1745
Copper, . . .	9000	Sand, ...	1520
Copper Pence, .	8915	Coal, ...	1250
Gun Metal, . .	8784	Mahogany, . .	1063
Cast Brass, . .	8000	Boxwood, . . .	1030
Steel, ...	7850	Sea Water, . .	1030
Iron, ...	7645	Common Water, .	1000
Cast Iron, . . .	7425	Oak, ...	925
Tin, ...	7320	Gunp'd'r shook close	937
Crystal Glass, .	3150	" in a loose heap	836
Granite, . . .	3000	Ash, ...	800
White Lead, . .	3160	Maple, ...	755
Marble, . . .	2700	Beech, ...	700
Hard Stone, . .	2700	Elm, ...	600
Green Glass, . .	2600	Fir, ...	550
Flint, ...	2570	Cork, ...	240
Common Stone, .	2520	Air at a mean state,	$1\frac{1}{3}$

Note.—The several sorts of wood are supposed to be dry. Also, as a cubic foot of water weighs just 1000 ounces, the numbers in this table express, not only the specific gravities of the several bodies, but also the weight of a cubic foot of each, in avoirdupois ounces; and therefore the weight of any other quantity, or the quantity of any other weight may be found, as in the next two propositions.

To find the Magnitude of any Body from its Weight.

Rule.—Place the weight of the material in ounces under its specific gravity; then opposite 1728 is its magnitude in cubic inches; and opposite 1 is the answer in cubic feet.

Example.—How many cubic inches of gunpowder are there in one pound weight, shaken close?

Place 16 (the number of ounces in a pound) opposite 937; then opposite 1728 is its content or magnitude, 29½ inches.

How many cubic inches are there in 3 pounds of cast brass?

Place 48 (the number of ounces in 3 pounds) opposite 8000; then opposite 1728 is the answer, 103·5.

To find the Weight of a Body from its Magnitude.

Rule.—Place the contents of the body opposite 1728; then opposite its specific gravity is its weight in ounces.

How many ounces avoirdupois in 864 cubic inches of sand?

Place 864 opposite 1728; then opposite 1520 (the specific gravity of sand) is 760 ounces, the answer.

Measure, &c.

5,280	feet in a mile.
63,360	inches in a mile.
190,080	barley-corns in a mile.
32,000	ounces make one ton.
43,560	square feet in an acre.
4,840	square yards in an acre.
32	gills in one wine-gallon.
7·22	cubic inches in a gill.
28·875	cubic inches in a pint.
57·75	cubic inches in a quart.
2,150·4+	cubic inches in a bushel.
1·2444	cubic feet in a bushel.
3,600	seconds in an hour.
86,400	seconds in a day of twenty-four hours.
31,557,600	seconds in a year.
1,728	cubic inches in a foot.
128	feet make one cord of wood.

Comparative Value and Weight of different kinds of Fire-wood, assuming as a standard the Shell-bark Hickory.

	Lbs. in a cord.	Compar. val.	$	cts.
Shell-bark Hickory,	4469	100	7	40
Button Wood,	2391	52	3	85
Maple,	2668	54	4	00
Black Birch,	3115	63	4	67
White Birch,	2369	48	3	56
White Beech,	3236	65	4	81
White Ash,	3420	77	5	70
Common Walnut,	4241	95	7	03
Pitch Pine,	1904	43	3	18
White Pine,	1868	42	3	11
Lombardy Poplar,	1774	40	2	96
Apple Tree,	3115	70	5	18
White Oak,	3821	81	6	00
Black Oak,	3102	66	4	89
Scrub Oak,	3337	73	5	40
Spanish Oak,	2449	52	3	85
Yellow Oak,	2919	60	4	44
Red Oak,	3254	69	5	11
White Elm,	2592	58	4	29
Swamp Whortleberry,	3361	73	5	40

NOTE.—It is estimated that a cord of wood contains, when green, 1443 pounds of water, equal to 1 hogshead and 2 barrels of water.


PALMER'S
POCKET SCALE
Months 5 per c.t
Months 6 per c.t
Months 7 per c.t
Months 8 per c.t
Days 5 per c.t
Days 6 per c.t
Days 7 per c.t
Days 8 per c.t
Cord
S.Foot
Acre
B.G.
D
W.G.